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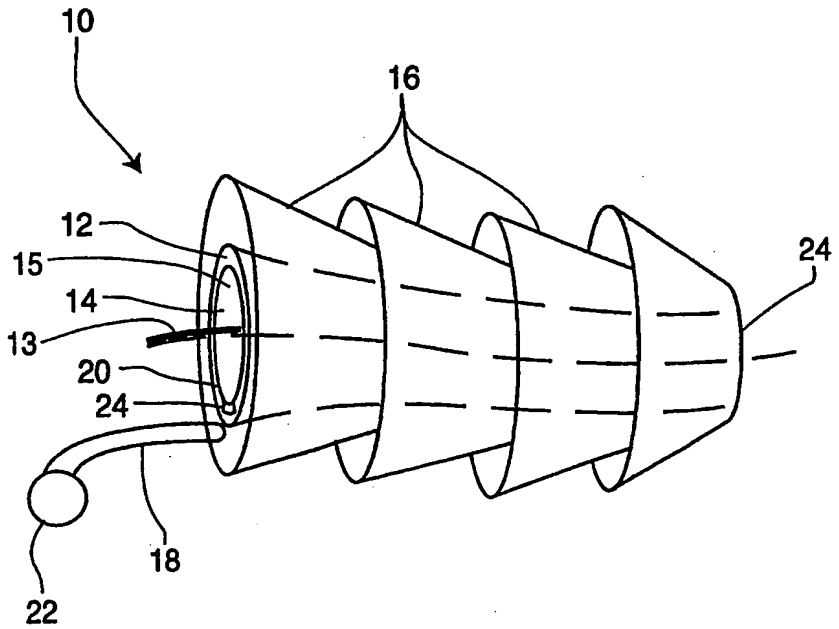

(57) Abstract

An earmold (10) and casing for a flexible hearing aid includes a cylindrical tube (12) of a soft, pliable material having a cylindrical passage (14) therethrough. A plurality of conical fins (16) project outward from the tube (12) and are along the entire length of the tube (12). The electronic components for the hearing aid are encased within the flexible tube (12). A pull (18) is secured to and extends from one end of the tube (12).

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EARMOLD AND CASING FOR A FLEXIBLE HEARING AID

Technical Field

The present invention relates to an earmold for a hearing aid, and, more particularly to a generic earmold for a hearing aid which fits tightly and comfortably in the canal of the ear of various sizes and shapes.

Background Art

Most hearing aids include an earmold which is inserted and retained in the canal of the ear of the user. The earmold may contain the electronics of the hearing aid, including the speaker, or may be connected to the electronics, which are outside the canal of the ear, by a tube. The earmold desirably fits comfortably in the ear and is formed in a manner that it is readily retained in the canal of the ear. Retention of the earmold in the canal of the ear can be accomplished by friction and/or by mechanical locking. Friction is created by radial pressure of the earmold on the wall of the canal. The more pressure, the greater is the retention force. However, friction is also dependent on lubricants between the earmold and the wall of the canal. The presence of cerumen (ear wax), perspiration or water significantly reduces friction retention. Therefore, mechanical locking is the primary means by which most hearing aids are retained in the ear. For mechanical locking, the earmolds are molded to fit the complex shape of the ear canal. These complex interlocking shapes hold the hearing aid in place without relying on friction so that they are not susceptible to the loosening caused by forces which tend to dislodge the hearing aid. However, the making of these complex interlocking shapes is a laborious, inaccurate and time consuming, process which often requires the user to make several visits to the audiologist or dispenser before an earmold with a secure fit can be made. This is not only time consuming, but also greatly increases the cost of the hearing aid.

Another problem which arises in hearing aids is acoustic feedback. Acoustic feedback occurs when amplified sound from the hearing aid's speaker enters the microphone and is subsequently re-amplified, resulting in a squealing noise. If the earmold fits well, it attenuates the sound sufficiently to prevent feedback. Therefore, a good fit of the earmold in the canal of the ear is desirable to minimize acoustic feedback. It has been demonstrated that soft earmolds are superior to hard earmolds in the reduction of feedback. However, the earmolds generally used which are specifically shaped to fit a particular ear canal are generally made of a hard material. This provides an earmold which has a longer life and which can be easily removed and reinserted for cleaning and repair.

Two of the more recent attempts at commercializing performed earmolds are shown in U.S. Patent No. 4,870,688 to B. Voroba et al., issued September 26, 1989, entitled MASS

PRODUCTION AUDITORY CANAL HEARING AID, and U.S. Patent No. 5,002,151 to R.J. Oliveira et al., issued March 26, 1991, entitled EAR PIECE HAVING DISPOSABLE, COMPRESSIBLE POLYMERIC FOAM SLEEVE. The earmold shown in the patent to Oliveira et al. uses a compressible retard recovery foam that can be compressed and then inserted into a person's ear, and allowed to recover to fill into the canal. This earmold is held in only by friction. Also, the earmold is connected to the electronics by a tube which has the tendency to pull on the earmold frequently and thus dislodge it. For this reason, these devices are limited to short trial periods.

The hearing aid shown in the patent to Voroba et al. uses a soft polymeric material in solid form. The earmold is designed to utilize both friction and mechanical locking. However, the earmold contains the electronics and the weight and cantilever of the hear aid dislodges the earmold over time. To support the cantilever, the Voroba et al. earmold is designed to fill in the canal and the concha. However, making a generic earmold which fits well both the canal and the concha is difficult. Also, the earmold of Voroba et al. is designed for several years of use, requiring that it be made of a harder material.

Disclosure of Invention

An earmold for a hearing aid includes a tube of a soft, pliable material. A plurality of fins project outwardly from the tube.

Brief Description of the Drawings

The figure of the drawing, is a perspective view of an earmold of the present invention.

Detailed Description

Referring to the Figure of the drawing, the hearing aid earmold of the present invention is generally designated as 10. Earmold 10 comprises a cylindrical tube 12 of a soft pliable material having a cylindrical passage 14 therethrough. A plurality of conical fins 16 project radially outwardly from the tube 12 and are along the entire length of the tube 12. An integral pull 18 extends from an end 20 of the tube 12. The pull 18 has a knob 22 on its end. A canal 24 is in the surface of the passage 14 and extends the full length of the tube 12.

The earmold 10 is molded from an elastomer to assure softness, durability and ease of use. Although various materials may be used to make the earmold 10, a preferred material is a heat cured silicone, which has an ideal combination of softness, durability, stability and demonstrated biocompatibility. Thermoplastic elastomers have the processability of thermoplastics and the performance properties of thermoset rubber. Also, thermoplastic elastomers cost one-tenth to one-twentieth the cost of silicone materials. Another advantage

of thermoplastic elastomers is their appearance and feel. Most are available in opaque, translucent or colorable grades and possess a smooth, warm feel.

In the use of the earmold 10 of the present invention, the entire electronics of the hearing aid may be inserted in the cylindrical passage 14. The electronics, including microphone, speaker, battery and the amplifier integrated circuit, may be mounted on a flexible printed circuit board 13 which is inserted in a hollow tube 15. The tube 15 is then be inserted in the passage 14 of the earmold 10. The tube 15 could be slightly larger in diameter than the passage 14 so as to have a tight fit therein. Also, the tube 15 could have a detent fitting in a recess in the wall of the passage 14 so as to secure the tube in the earmold 10. Alternatively, the electronics could be outside the earmold and connected to the earmold by a tube, such as shown in U.S. Patent No. 5,002,151 to Oliveira et al.

The earmold 10, being very compliable, conforms to the general shape of the hollow tube or casing containing the electronics. It is generally known that the ear canal has two natural bends therein, which are often referred to as the first and second bends. If the electronic casing or shell is designed to have these bends as part of its form, and the earmold conforms to these bends, then the earmold takes on these natural bends which provides for mechanical locking. As the earmold and electronics are pushed into the ear. the outer fins compress as does the ear canal's skin and subcutaneous cartilage. Once the earmold is fully inserted, it has a soft but definite locking effect. The ear canal is then in it normal or uncompressed state, but the earmold's conical fins remain compressed to some degree to hold the earmold firmly in the ear.

To use the earmold 10, the user inserts the earmold 10 into the ear with the end 24 of the tube 12 being inserted first. The user presses on the end 20 of the tube 12 to push it into the ear. As the earmold 10 moves into the ear, the fins 16 gently compress as they travel inwardly. When the earmold 10 reaches the inner canal bend, the earmold 10 tends to lock into place. Thus, the earmold 10 is held in the ear of the user by both friction and mechanically. To remove-the earmold 10, the user merely pulls on the pull 18 which is integrally molded on the end 20 of the earmold 10. Thus, the earmold 10 can be easily inserted and removed from the ear. Once in the ear, the earmold is held in the ear by both friction and mechanically. Since the earmold 10 is made of a soft, pliable material, it fits comfortably in the ear.

Venting is a means in earmolds to provide intentional sound leakage and to relieve a feeling of pressure in the ear. The canal 24 in the tube 12 provides for such a leakage. The canal 24 can be small, having a diameter of about 0.6 mm, so that it will make little difference to the frequency response and prevent feedback. However, it will be effective in

allowing pressure equalization to reduce the feeling of pressure that many hearing aid users experience. The canal 24 may be enlarged to effect frequency response and further improve the user's overall acoustic benefit.

Thus, there is provided by the present invention an earmold for a hearing aid which is made of a soft, pliable molded material and which has conical fins projecting from its outer surface. This provides an earmold which fits comfortably in the ear and is held in the ear by both friction and mechanically. The earmold can be made in a minimum of different sizes to fit a large variety of sizes of ears. Since the earmold is made of a pliable material and has the fins projecting therefrom, one size of the earmold can fit into a large variety of sizes of ears. The earmold can contain the entire electronics of the hearing aid or can be connected to the electronics which are outside of the earmold by a connecting tube. In addition, the earmold can be molded easily and inexpensively so that it is disposable.

What is claimed is,

1. An earmold and casing for a flexible hearing aid implemented on a flexible circuit board, the earmold and casing comprising:

a first flexible tube, having an outside diameter, the first flexible tube being adapted to receive the flexible circuit board;

a second flexible tube, made of a soft, pliable material, the second flexible tube having an inside diameter which is expandable to receive the first flexible tube, wherein the first flexible tube is fully enclosed within the second flexible tube; and

a plurality of fins projecting outwardly from the second flexible tube.

2. The earmold and casing of claim 1 wherein the fins are along the entire length of the second flexible tube.

3. The earmold and casing of claim 3, in which the fins are conical.

4. The earmold and casing of claim 3 in which the second flexible tube is cylindrical and has a cylindrical passage therethrough, the cylindrical passage defining an inside surface of the second flexible tube.

5. The earmold and casing of claim 4 including a cord secured to and extending from one end of the second flexible tube.

6. The earmold and casing of claim 5 in which the second flexible tube has first and second ends and the cylindrical passage extends from the first end to the second end and includes a canal in the inside surface of the second flexible tube and extending from the first end of the tube to the second end of the tube, wherein when the first flexible tube is inserted into the second flexible tube, the canal forms a passageway through which air may pass between first and second ends of the earmold and casing.

7. The earmold and casing of claim 6 in which the second tube is made of a thermoplastic elastomer.

8. An earmold and casing for a flexible hearing aid implemented on a flexible circuit board, the earmold and casing comprising:

a first flexible tube, having an outside diameter, the first flexible tube being adapted to receive the flexible circuit board;

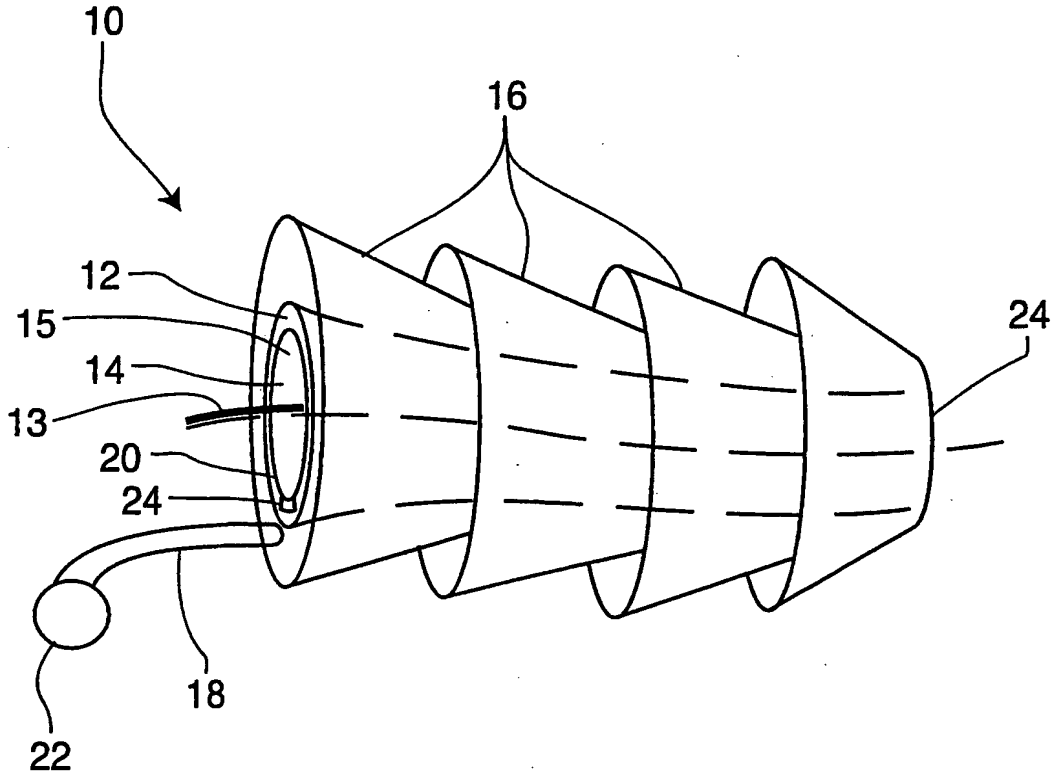
a second flexible tube, made of a soft, pliable material, the second flexible tube having first and second ends, an inside surface, and an inside diameter which is expandable to receive the first flexible tube, wherein the first flexible tube is fully enclosed

within the second flexible tube and the second flexible tube includes a canal in the inside surface of the second flexible tube and extending from the first end of the tube to the second end of the tube, wherein when the first flexible tube is inserted into the second flexible tube, the canal forms a passageway through which air may pass between the first and second ends of the second flexible tube; and

a plurality of fins projecting outwardly from the second flexible tube.

9. The earmold and casing of claim 8 including a cord secured to and extending from one end of the second flexible tube.

10. The earmold and casing of claim 8, in which the fins are conical.



INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04R 25/00
US CL :381/68.6
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 381/68.7; 181/129, 130, 135

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,606,621 A (REITER ET AL) 25 February 1997 (25.02.97), see entire document.	1-10
A	US 2,939,923 A (HENDERSON) 07 June 1960 (07.06.60), see entire document.	1-10
A	US 5,068,902 A (WARD) 26 November 1991 (26.11.91), see entire document.	1-10
A	US 2,430,229 A (KELSEY) 04 November 1947 (04.11.47), see entire document.	1-10
A	US 2,487,038 A (BAUM) 08 November 1949 (08.11.49), see entire document.	1-10
A	US 2,987,584 A (WEBBER ET AL) 06 June 1961 (06.06.61), see entire document.	1-10

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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A	US 3,080,011 A (HENDERSON) 05 March 1963 (05.03.63), see entire document.	1-10